

DATE.	YEAR.	FEET.	INCHES.
1873	December 18th.....	44	5
1874	January 11th.....	47	11
1875	August 26th.....	56	4
1876	January 26th.....	51	9
1877	January 26th.....	53	9
1878	December 15th.....	41	4
1879	December 27th.....	42	9
1880	February 17th.....	53	2
1881	February 16th.....	50	7
1882	February 20th, 6 a. m.....	54	1
1882	February 20th, 11.30 a. m.....	54	11
1882	February 20th, 12.40 p. m.....	55	7
1882	February 20th, 2.50 p. m.....	55	10
1882	February 20th, 5.30 p. m.....	56	3
1882	February 20th, 7 p. m.....	56	6
1882	February 21st, 8 a. m.....	55	6

## TEMPERATURE OF WATER.

The temperature of water as observed in rivers and harbors at Signal Service stations, with the average depth at which observations were taken, is given in the table on the right hand of chart ii. Observations on temperature of water were not taken at the following-named stations, on the dates given, on account of ice in harbors: Escanaba, first to eighth, inclusive; Marquette, first to sixth; Duluth, first to twenty-seventh.

In the first column of the table is given the maximum temperature observed during the month; and in the second column the minimum temperature observed during the month. It will be seen that the greatest range of water temperature occurred at the west Gulf stations, where it ranged from 18°.4 at Indianola to 19° at Galveston. At the stations on the eastern Gulf the smallest ranges in water temperature were reported.

The following table gives the highest and lowest temperature of water observed at the several stations, with the range of water temperature, mean temperature of the air at the station, and the depth of water at which the observations were taken:

Temperature of Water for April, 1882.

	Temperature at bottom.		Range.	Average depth in feet and inches.	Mean temperature of the air at station.
	Max.	Min.			
Atlantic City.....	53.3	45.	8.3	ft. in.	46.8
Alpena.....	44.	31.	13.0	12 0	36.7
Augusta.....	74.6	63.5	11.1	8 9	66.6
Baltimore.....	54.5	47.5	7.0	9 8	52.0
Boston.....	45.6	39.5	6.1	25 0	42.0
Buffalo.....	49.9	38.6	11.3	10 0	40.8
Burlington.....	38.3	34.	4.3	19 5	38.7
Cedar Keys.....	79.	71.	8.0	8 7	73.4
Charleston.....	45.	35.	10.0	40 8	66.6
Chicago.....	49.9	42.1	7.8	7 9	45.8
Chincoteague.....	59.	48.	16.0	6 4	45.9
Cleveland.....	50.	40.4	9.6	14 0	44.4
Detroit.....	46.	37.	9.0	24 2	45.9
Duluth.....	36.	34.5	1.5	13 3	37.5
Eastport.....	37.3	33.3	4.0	16 2	35.0
Escanaba.....	44.	33.	11.0	15 0	36.6
Galveston.....	77.	58.	19.0	14 9	72.5
Grand Haven.....	49.	30.5	18.5	19 0	45.6
Indianola.....	79.	60.6	18.4	9 3	73.1
Jacksonville.....	76.	71.	5.0	18 0	70.9
Key West.....	85.	73.5	11.6	17 2	78.5
Marquette.....	58.9	31.8	7.1	10 7	36.5
Milwaukee.....	47.1	39.6	7.5	8 0	42.8
Mobile.....	70.3	65.	5.3	16 0	70.5
New Haven.....	51.2	39.7	11.5	14 9	43.5
New London.....	46.	40.	6.0	12 11	44.7
Newport.....	46.	38.5	7.5	10 9	41.1
New York.....	49.3	41.3	8.0	23 2	46.1
New Shoreham.....	46.1	39.3	7.7	9 4	43.2
Norfolk.....	61.	54.	7.0	16 10	53.7
Pensacola.....	73.5	66.7	6.8	18 0	70.4
Portland, Me.....	42.	34.	8.0	19 2	43.3
Portland, Oreg.....	52.3	43.2	9.1	72 11	48.5
Port Eads.....	68.	64.	4.0	9 10	72.7
Provincetown.....	47.5	38.5	9.0	14 0	41.7
Punta Rasa.....	58.5	72.6	12.9	11 9	73.3
Sandusky.....	62.1	39.8	12.3	10 1	46.2
Sandy Hook.....	48.0	42.5	5.5	2 1	46.8
San Francisco.....	54.6	53.3	1.3	20 0	53.4
Savannah.....	71.4	64.9	6.5	13 4	68.0
Smithville.....	72.0	61.0	11.0	10 0	62.2
Toledo.....	55.	42.	13.0	11 9	46.5
Wilmington.....	69.5	61.5	8.0	13 0	63.2

## ATMOSPHERIC ELECTRICITY.

## AURORAS.

Auroral displays were of unusual frequency during the month. The display which began on the evening of the 16th was the most extraordinary that has occurred for many years, and was visible at a great number of stations throughout the United States. It was observed as far south as Key West, at stations in the Gulf states, in southern Texas, New Mexico, and California and by numerous steamships and vessels. On vessels in the north Atlantic, during the display, the magnetic needle deviated north and south of its true position; and long telegraphic circuits, extending north and south, east and west, in the United States were worked without the aid of battery. The following extract from a communication, published in "Nature," from Mr. A. G. Whipple, an English scientist, shows that its influence was also felt in England:

"It may interest some of your readers to know that a magnetic storm of unusual intensity raged from about midnight of Sunday, the 16th, to midnight of the 17th. We observe a tremendous spot which appeared on the sun's disc, first on the 13th, is now rapidly approaching the central meridian, and a group observed on Saturday a little in advance of it, appears to have undergone considerable change in the interval.

(Signed.)

G. M. WHIPPLE,

Kew Observatory, Richmond, Surrey.

April 18th, 1882."

Eastport, Maine, 16th, a faint diffuse auroral light appeared in the north at 8 p. m. It gradually rose toward the zenith, increasing in brilliancy. At 8.30 p. m. a striated arc extending from northwest to northeast, with a breadth of 15° and altitude of 45°. At 8.40 p. m. the arc dissolved into numerous beams, all parallel to each other and pointing toward the zenith. At 9 p. m. the whole northern sky from west to east was filled with beams, some of which were of blood red and others of light red color. It continued to extend southward and at eleven p. m. reached the zenith, forming a half crown. At eleven thirty p. m., the whole sky was filled with beams, all pointing toward the zenith, forming a perfect corona, and some of the beams reaching within 10° of the southern horizon. At 11.40 p. m. the aurora became slightly obscured by cirrus clouds. At midnight it was still visible, though rapidly fading. Telegraphic communication was seriously interrupted by its influence.

Washington, District of Columbia, 16th, an aurora was visible at 9.54 p. m., in the form of an arc, 2° in width and about 6° above the northern horizon; the base of the dark segment measuring about 35°. At 11 p. m., the arc was quite brilliant and of increased dimensions; the pale green light which had been formerly observed had then become quite strong; the summit of the arch had reached an altitude of 12°, the arch itself being fully 8° in width, while the base of the segment measured about 55°. At 11 p. m., a few faint streamers projected not more than 3° above and from the corona of the arch. At eleven post-meridian, the summit of the arch reached an altitude of 20° and extended from 100° to 250° azimuth; brilliant streamers, narrow and pointed at the ends, shot upward to the zenith from the whole length of the arch; the upward motion was very rapid, and resembled flashes of lightning. The streamers gradually diminished in length and brilliancy after midnight, and at 12.40 a. m. of seventeenth no motion was perceptible. At 12.45 a. m. the arch was faintly defined and without streamers. At 1.00 a. m. the arch was again well defined and of brighter color. At one-thirty the aurora revived, but did not equal its former brilliancy; the crown of the arch had an elevation of about 10°, without any change in its azimuth; broad streamers flashed upward at short intervals, some extending nearly to zenith. At 2 a. m. the streamers subsided, and at 2.12 a. m. the arch broke up into faint bands of light. At two-twenty-five only a faint light remained in the northern sky. At

3.40 a. m. a small, well-defined arch of about  $5^{\circ}$  altitude and  $30^{\circ}$  azimuth, without streamers, was visible. At 4 a. m. a few streamers without motion were observed, and continued until daylight. The color of the aurora throughout the entire display was a pale yellow, with the exception of a broad streamer at the western extremity, which from 11.30 to 11.40 p. m. was of bright crimson. At Key West, Florida, from 1 to 1.30 a. m. on the 17th, the aurora was observed, consisting of a diffuse light, resembling the morning twilight, extending to an altitude of  $10^{\circ}$ , and from  $134^{\circ}$  to  $190^{\circ}$  azimuth.

Chicago, 16th, Aurora observed at 9.40 p. m., consisting of a hazy segment of  $15^{\circ}$  altitude, surmounted by an arch of light about  $5^{\circ}$  broad, extending from about  $40^{\circ}$  east of north to  $30^{\circ}$  west of north. The arch slowly ascended and at 10.15 p. m. was of about  $40^{\circ}$  altitude. During the next ten minutes the arch widened toward both zenith and horizon, and disappeared, leaving only a faint glow. At 10.30 p. m., vertical columns began to shoot upward from near the north point, toward the zenith, which were soon accompanied by similar displays from first the west, and afterward from the east; the aurora meanwhile having extended laterally to about  $55^{\circ}$  west of north and to about  $70^{\circ}$  east of north. The shafts gradually extended laterally and finally converged to a point about  $15^{\circ}$  south of the zenith, changing in color from pale yellow to blue, red and crimson, shooting up and down from horizon to zenith, resembling a ray of sunlight reflected from a rapidly rotated mirror. About 10.45 p. m. it reached its maximum brilliancy. The point of convergence near the zenith, a circular black nucleus presented a decided contrast to the brilliancy of the converging beams, which varied from a deep red at their summits, to a pale blue near the horizon. At this time the display covered two-thirds of the sky. At irregular intervals, a tremulous swinging movement from east to west, and vice-versa, was observed. At 10.55 p. m. it began to fade, and at eleven post-meridian only a faint glow remained, varied by occasional feeble beams shooting from the horizon toward the zenith. The wires of the various telegraph offices were unusually affected. At the Western Union Office, the batteries were detached and the wires worked to both Omaha and New York, the current being very powerful. Wires running north and south were also much affected but not nearly so powerfully as those running east and west. The display continued until daylight of the 17th, and was characterized by recurring fits;—consisting chiefly of vertical shafts shooting upward from the horizon with great rapidity and quickly disappearing, and a faint luminous glow resembling dawn.

At Indianola, Texas, the aurora was observed from 10 to 10.30 p. m. in the northern sky extending  $10^{\circ}$  east and  $10^{\circ}$  west of the magnetic meridian and to an altitude of  $45^{\circ}$ ; no streamers or arch were visible but the aurora consisted of a diffuse pale red light, resembling the light of a distant prairie fire.

At Olympia, Washington Territory, from 12.30 to 12.50 a. m. the aurora was observed through broken clouds, resembling the glow of a distant fire.

At San Francisco, 16th, 8.15 p. m., an unusually brilliant aurora of deep crimson color, spread over the northern sky, extending to an altitude of  $35^{\circ}$ , with a wavy motion which soon afterwards settled to a dull steady glow and gradually died away at 9.30 p. m. At 11 p. m. it appeared again, consisting of several columns of white to orange color, extending to a height of  $75^{\circ}$ . The display attracted the attention of a large number of spectators, who imagined it to be the reflection from a large fire. At Visalia, California, the display began at 8.35 p. m. The northern sky from east to west was of a fiery color, with a motion from east to west; its greatest brilliancy occurred between 8.35 and 9 p. m.; altitude  $50^{\circ}$ ; azimuth  $135^{\circ}$ ; it remained visible until 4 a. m. of 17th.

The following interesting report furnished from the United States steamer "Vandalia," in lat.  $30^{\circ} 10' N.$ , long.  $78^{\circ} 19' W.$ , by Captain R. W. Mead, United States Navy, commanding, is of special interest: A very remarkable aurora-borealis was noticed, beginning at 10 p. m., Sunday, April 16th, and ending

about 4:30 a. m., Monday, April 17th, 1882. It was preceded by an arc of greenish hue, the base of which was about  $45^{\circ}$  in length, with its centre not more than  $10^{\circ}$  in height, directly under the Pole star. This lasted about half an hour, when wave-like shafts of light of different shades of pink, blue, yellow and greenish white colors shot up, all converging toward a common point, about  $20^{\circ}$  directly above the north star. The base increased one point, ending at n.n.e. and the other at w.n.w. Evidently the compass was affected, for when the light at the northern point increased in intensity, the ship, apparently came to windward of the course, (attributed at the time to bad steering,) but when the light at the western end increased in brilliancy, the ship, apparently, fell off to the leeward. The compass course was northeast by east; wind east by north.

The display next in importance to that of the 16th, was observed during the evening of the 19th and early morning of 20th. At many stations it was scarcely less brilliant than that of the 16th. It was observed from stations in New England westward to Umatilla, Oregon, and southward to Nashville, Tennessee, and at Phoenix, Arizona. Displays of less importance and of varying brilliancy, also occurred on the following dates: 5th, 13th to 24th, 28th, 29th.

#### THUNDER STORMS.

They were reported in the various districts on the following dates:

*New England*, 2d, 4th, 6th, 7th, 19th, 20th.

*Middle Atlantic states*, 2d to 4th, 6th, 9th, 10th, 12th, 14th, 19th, 20th, 22d, 23d, 26th, 27th, 28th, 30th.

*South Atlantic states*, 2d to 5th, 7th to 10th, 12th, 19th, 20th, 22d, 23d, 27th to 29th.

*Florida peninsula*, 8th, 10th, 15th, 20th.

*East Gulf states*, 2d, 3d, 5th to 13th, 17th to 20th, 22d, 26th to 29th.

*West Gulf states*, 2d, 5th to 12th, 18th, 19th, 21st, 22d, 26th to 29th.

*Rio Grande valley*, 7th, 8th, 26th, 28th, 29th.

*Ohio valley and Tennessee*, 2d to 4th, 6th to 9th, 18th, 19th, 21st to 23d, 26th to 28th.

*Lower lake region*, 1st, 2d, 4th, 6th, 7th, 19th, 27th, 28th.

*Upper lake region*, 1st to 4th, 6th to 9th, 18th, 19th, 22d, 26th, 27th.

*Upper Mississippi valley*, 1st to 9th, 18th, 21st, 22d, 25th, 26th.

*Missouri valley*, 1st to 8th, 11th, 17th to 19th, 21st, 22d, 25th, 26th, 28th.

*Southern slope*, 4th, 5th, 7th, 10th, 11th, 21st, 26th to 30th.

*Southern plateau*, 1st, 3d, 12th to 14th, 16th, 29th, 30th.

Thunder-storms were also reported from the following stations not included in the districts named above: Bismark, Dakota, on the 7th; Blackfeet Agency, Montana, on 24th; Fort Custer, Montana, 6th; Terry's Landing, Montana, 24th; Fort Washakie, Wyoming, 11th; Fort Collins, Colorado, 17th; Pike's Peak, 4th; North Platte, Nebraska, 4th, 8th, 17th, 25th; Dodge City, Kansas, 7th; Spokane, Washington, 26th; Eagle Rock, Idaho, 3d; Boise City, Idaho, 22d; Fort McDermitt, Nevada, 3d.

During thunder-storms the following instances of damage by lightning occurred: Burlington, Vermont, 6th, at Winooska Falls, during morning, a church was struck by lightning; a cross on the building was thrown down and a quantity of slating was torn off. Chattanooga, 22d, a tree was struck by lightning; a person in vicinity was stunned and a cow killed. Friendship, New York, 2d, 6 a. m., lightning struck an oil-tank and two derricks. Buffalo, 2d, the railroad station at Buffalo Plains was struck by lightning, set on fire and destroyed. Another building was also consumed at the same time.

#### OPTICAL PHENOMENA.

##### SOLAR HALOS.

*Solar halos* have been observed in the various districts on the following dates: